COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

Juan D. Yepes

for the degree of Doctor of Philosophy (Ph.D.)

"Collision free navigation in 3D unstructured environments using visual looming"

July 5th, 2023, 1 pm
EE-96, Room 405
777 Glades Road
Boca Raton, FL

DEPARTMENT:
Electrical Engineering and Computer Science

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ABSTRACT OF DISSERTATION
Dissertation Title: Collision free navigation in 3D unstructured environments using visual looming.
Abstract:
This dissertation introduces a scalable and efficient approach for collision-free navigation by focusing on 'visual looming,' a concept based on the relative expansion of the projection of 3D objects on an image sensor. Visual looming is independent of camera rotation and orientation, offering a broader scope than the traditional 'Time-To-Contact' (TTC) concept. It is suitable for dynamic, unstructured as well as structured environments. The work presents a novel mathematical formulation for visual looming, based on the motion field during 6DoF relative motion, which is verified using Unity3D simulations. We propose a new optical flow-based estimation method for calculating visual looming, which utilizes spatial and temporal derivatives. Moreover, we introduce a new method that uses LiDAR (Light Detection and Ranging) and IMU (Inertial Measurement Unit) data to calculate looming. Both methods are validated with real data using the well-known KITTI dataset. Additionally, we offer a novel technique for obtaining ground truth visual looming data from synthetic animations, enabling the creation of datasets for training machine learning models to predict visual looming from raw image sequences. The proposed approach enables collision-free navigation and other tasks in any dynamic environment without 3D reconstruction or knowledge of the observer's egomotion, by using only a single moving image sensor.

BIOGRAPHICAL SKETCH
Born in Medellin, Colombia
B.S., Universidad Pontificia Bolivariana, Medellín, Antioquia, Colombia, 1992
M.S., Florida Atlantic University, Boca Raton, Florida, 1994
M.B.A., Phoenix University, Phoenix, Arizona, 2009
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CONCERNING PERIOD OF PREPARATION
& QUALIFYING EXAMINATION

Time in Preparation: 2020 - 2023

Qualifying Examination Passed: Fall 2020

Published Papers:

Yepes, J. and Raviv, D. (2023). Visual Looming from Motion Field and Surface Normals. In Proceedings of the 9th International Conference on Vehicle Technology and Intelligent Transport Systems - VEHITS; ISBN 978-989-758-652-1; ISSN 2184-495X, SciTePress, pages 46-53. DOI: 10.5220/0011727400003479

https://www.scitepress.org/publishedPapers/2023/117274/pdf/index.html

Yepes, J. and Raviv, D. (2022). Estimation of Looming from LiDAR. In Proceedings of the 8th International Conference on Vehicle Technology and Intelligent Transport Systems - VEHITS; ISBN 978-989-758-573-9; ISSN 2184-495X, SciTePress, pages 455-462. DOI: 10.5220/0011115300003191

https://www.scitepress.org/publishedPapers/2022/111153/pdf/index.html

Raviv, D., & **Yepes, J.** (2023). A visual, intuitive, and engaging approach for explaining the concept of feedback in control systems. ASEE Southeast Section Conference. https://monolith.asee.org/public/conferences/329/papers/36676/view

Raviv, D., & **Yepes, J.** (2023). On Teaching and Learning the Concept of Derivative in Visual and Intuitive Ways. ASEE Southeast Section Conference. https://monolith.asee.org/public/conferences/329/papers/36648/view

Macri, V. A., Raviv, D., & **Yepes, J.** (2023). From equations to actions: A system-level design research experience of an undergraduate student. ASEE Southeast Section Conference. https://monolith.asee.org/public/conferences/329/papers/36671/view